Trustee Council Use Only
Project No: _____
Date Received: _____

GEM PROPOSAL SUMMARY PAGE

(To be filled in by proposer)

Project Title:	Investigating the relative roles of natural factors and shoreline harvest in altering the community structure, dynamics and diversity of the Kenai Peninsula's rocky intertidal, submitted under the BAA
Project Period:	Federal fiscal years--October 1st to September 30th-- FY 04
Proposer(s):	Jennifer Li Ruesink, Biology, University of Washington, Box 351800, Seattle, WA, 98195-1800
Study Location:	Kenai Peninsula
Abstract:	The surf swept rocky shores of the outer Kenai Peninsula are the home of three Sugpiaq native villages where the black chiton, *Katharina tunicata,* remains an important traditional subsistence food source. This benthic invertebrate is also a competitively dominant herbivore known to have dramatic impacts on the structure, dynamics and diversity of the rocky intertidal. In collaboration with tribal members, we will evaluate the relative roles of natural factors (predation/grazing & natural variability) and anthropogenic impacts (*Katharina* harvest) in altering intertidal community structure. The project addresses the core GEM hypothesis of human versus natural impacts on the structure and productivity of coastal ecosystems. It will also provide an additional field season (2004) of valuable baseline monitoring in the intertidal zone that could be continued in the future as part of a long-term time series. Local tribes will be involved in both developing and carrying out research which will match the GEM commitment to community based science.
Funding:	EVOS Funding Requested: FY 04 $ 81,707 FY 05 $ FY 06 $ TOTAL: Non-EVOS Funds to be Used: FY 04 $ FY 05 $ FY 06 $ TOTAL:
Date:	Date proposal prepared

(NOT TO EXCEED ONE PAGE)

GEM RESEARCH PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

The Black chiton, *Katharina tunicata*, is a dominant herbivore known to affect intertidal community structure along rocky shorelines of the Pacific Northwest (Dethier and Duggins 1984, Duggins and Dethier 1985, Markel and DeWreede 1998, Paine 2002) and southeast Alaska (Dethier and Duggins 1988). Its range spans surf swept rocky shores from Oregon to Alaska (Kozloff 1973, O'Clair and O'Clair 1998). Known as 'Bidarki' in Chugach Aluutiq and "Ohuduck" in Sugcestun, *Katharina* also represents an important component of coastal native diets and culture (Russell 1991, Chugachmiut 2000). Because of its central role in both the ecological and cultural dynamics of coastal Alaska, *Katharina* should be a focal species for investigating natural and anthropogenic change in the rocky intertidal zone.

We propose to investigate the relative roles of natural factors (predation, grazing, wave force and recruitment) and anthropogenic impacts (*Katharina* harvest) in altering the community structure, dynamics and diversity of the rocky intertidal. This research will be conducted at the northernmost tip of the Kenai Peninsula, home of the Sugpiaq people of Port Graham, Nanwalek and Seldovia. We will determine the ecological ramifications of traditional native subsistence harvest of *Katharina* by comparing the algal and invertebrate species assemblages of heavily harvested shores close to the native villages (ecological "treatments") with more distant, unharvested shores (ecological "controls"). Because these treatments and controls are not randomly assigned, large- and small-scale manipulations of *Katharina* densities will allow us to test the effects of intertidal harvest directly. Other factors that could influence *Katharina* are predation by sea otters (Nickerson 1989), differential recruitment of planktonic larvae, and removal of adults by waves (Denny 1995). Whatever the cause, variation in *Katharina* density is likely to cause "domino effects" in the rest of the biotic community. In smaller-scale studies in other coastal areas, herbivory by *Katharina* alters the dominant space occupant and reduces intertidal productivity by up to an order of magnitude (Paine 1992, 2002). We will link this research to resource management by measuring *Katharina* survival, growth and length-specific fecundity. These demographic values will inform estimates of sustainable harvest, as well as allow us to test for density-dependent responses that could promote recovery of exploited populations.

Pilot work on this project was initiated by academic researchers, resource managers, and tribal members in the summer of 2002. Primary personnel include Anne Salomon, a graduate student in the Zoology Department at the University of Washington, Paul McCollum from the Chugach Regional Resource Council, Lydia McMullen, the Senior Fish Culturist at the Port Graham Hatchery, and Jim Miller, Port Graham's Natural Resource Specialist. In June and July 2002, baseline surveys were carried out at eight sites to document *Katharina* population size structure and density and the composition of intertidal assemblages. Results show that *Katharina* becomes increasingly common at sites that are less visited for subsistence harvest. The gradient applies mainly to larger individuals, whereas small *Katharina* are more evenly distributed across sites (Figure 1A&B). Field work for 2003 has begun, with an early emphasis on surveys of community structure, marking of several hundred *Katharina*, and experimental harvests at largely unharvested sites. Due to the current extent of native community involvement with this project (Figure 2 & 3), this proposed research can serve as a pilot study to inform

Project 03575, 'Designing a Community Involvement / Community Based Monitoring Plan for GEM'. Biodiversity surveys will use protocols compatible with those developed by the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and the Kachemak Bay National Estuarine Research Reserve (KBNERR), which GEM may be adopting (http://www.oilspill.state.ak.us/events/Nearshore_2002).

Human activities now alter most of the earth's ecosystems, including coastal regions (Vitousek et al. 1986, Pauly & Christensen 1995). This ever-increasing anthropogenic impact accompanies a growing recognition that natural forcing functions are also dynamic (Francis and Hare 1994). Thus, a key challenge in understanding and predicting ecosystem productivity and resilience is to disentangle natural and anthropogenic change. Although long-term monitoring is appropriate for detecting change, shorter-term process studies must be used to explore the causes of this change. Indeed, baseline biological monitoring programs designed to serve as sentinel systems against which future change can be measured must incorporate the extent and magnitude of current anthropogenic impacts.

Because of the legacy of Exxon Valdez, it is easy to think of oil spills as the primary anthropogenic factor influencing intertidal assemblages. However, intertidal systems in many areas have been subject to – and coexisted with – tribal harvest of resources for thousands of years. Thus, another key anthropogenic factor to consider as it influences system productivity is direct exploitation in the intertidal zone. The black chiton *Katharina tunicata* is the primary invertebrate harvested in the rocky intertidal by coastal Alaskan Natives. Large individuals (= 6cm) are harvested during spring, summer and fall low tides and are eaten steamed, raw or incorporated into other traditional dishes. The tribes of Port Graham and Nanwalek have recently observed a decline of this benthic resource around their villages and consequently have had to move farther afield to harvest large individuals (Nick Tanapee, Simeon Kvasnikoff personal communication).

In pilot research in 2002, we documented lower densities of large *Katharina* at accessible, harvested sites vs. less-accessible, less-harvested sites (Figure 4). These results are consistent with strong negative impacts of humans on this dominant intertidal herbivore. However, natural factors undoubtedly also affect *Katharina* distributions. Some of the most likely include current patterns that influence larval delivery, predation by sea otters, and dislodgement by waves. Although we cannot manipulate these natural factors experimentally, we will monitor them at all study sites to determine how much of the variation in *Katharina* density can be explained by these natural factors.

Anthropogenic effects on *Katharina* are unlikely to be restricted to that species. As it grazes, this chiton can selectively remove species of algal sporelings, and it also "bulldozes" small invertebrates. Previous research on the impact of *Katharina tunicata* has revealed that this species can alter both the abundance and size structure of intertidal kelp (Duggins and Dethier 1985, Paine 1992, Markel and DeWreede 1998, Paine 2002) and invertebrate species (Dethier and Duggins 1984, Dethier and Duggins 1988). Research carried out by a member of the project team revealed a significant relationship between *Katharina* abundance and intertidal biodiversity in British Columbia (Salomon 2000). Indeed, *Katharina* is likely to structure intertidal communities in a manner well-documented in marine systems: When dominant consumers are removed from a system, direct and indirect community-level effects may follow (Castilla and Duran 1985, Castilla and Bustamante 1989, Jackson et al. 2001). Their food sources, once released from consumption, may increase, which can cause other species to decline. Jackson et

al. (2001) propose that the removal by humans of top predators in marine systems has been a major contributor to altered community structure and collapse of productive natural resources.

Because of its cultural and ecological roles, *Katharina* should be the focus of process-oriented research on what factors influence its distribution and on how it in turn affects system structure and function as a whole. Changes in *Katharina* density may have "domino effects" on other intertidal species, which may cause dramatic spatial or temporal variation in long-term monitoring.

B. Relevance to GEM Program Goals and Scientific Priorities

Although the black chiton *Katharina tunicata* is ecologically and culturally important in coastal Alaska, it was not reported as an injured resource after the Exxon Valdez oil spill. This may be due to the fact that it tends to occur on more wave-exposed shorelines and lower in the intertidal zone than where most of the oil landed. However, *Katharina* does serve as a prey item for species that were injured by the oil spill, including sea otters and black oystercatchers (Wootton 1997). The primary rationale for a focus on *Katharina* is to increase "critical ecological information" about natural and anthropogenic drivers of intertidal structure and function. Furthermore, the Bidarki has been identified as an important subsistence species needing further study at the Tribal level through the Tribal Natural Resource Management planning process.

In the intertidal zone, the GEM program document poses the question of how natural and anthropogenic factors influence community structure and function. In locations where it has been studied, *Katharina* plays a central ecological role in the lower intertidal zone, influencing both species composition and productivity (Paine 1992, 2002).

To DETECT change, this project will provide a three year time series of *Katharina* population and community assemblage / biodiversity data, which local tribal members are involved in designing and implementing. The second year proposed here will complement data collected in 2002-03, and local citizens could pursue monitoring over the longer term. To UNDERSTAND causes of change, this project focuses on the impacts of direct exploitation of a strongly-interacting intertidal species while accounting for natural variation in the species that could be due to recruitment, predation, or physical constraints. PREDICTING the status of natural resources in the future is a difficult task, but many models require parameter values for demography and species interactions. The research we propose will provide demographic information on *Katharina*'s survival, growth, and reproduction. In particular, we will examine whether these parameter values increase at low density, which could aid recovery of exploited populations. By involving tribal members in the design and implementation of this research, we will INFORM coastal communities about scientific methods and results. This information will be valuable to the native coastal Alaskans who use this resource and to the scientific community interested in understanding how food webs are altered by exploitation.

The information collected throughout this project will be georeferenced and made available to the public and interested agencies and scientists through a regularly updated web site and through required FGDC metadata procedures.

II. PROJECT DESIGN

A. Objectives

1. Determine and compare the spatial variation of *Katharina* density and size structure and intertidal biodiversity / community structure at sites within traditional subsistence harvest areas and unharvested control sites. (Note some sites already chosen and described in section III D)

2. Quantify the ecological role of *Katharina* in structuring intertidal communities through experimental removals of *Katharina*.

3. Estimate the fecundity, survival and growth of *Katharina tunicata* to compare demography at exploited and unexploited densities.

4. Promote community involvement in practical, applied research that will provide useful information to both the native and scientific communities through education and hands on experience.

B. Procedural and Scientific Methods

1. Spatial Variation of *Katharina* Density and Size Structure and Intertidal Biodiversity / Community Structure

Null Hypothesis #1: There is no difference in Katharina density or population size structure between harvested and unharvested sites.

Null Hypothesis #2: There is no difference in invertebrate and algal assemblage between harvested and unharvested sites.

Null Hypothesis #3: There is no difference in algal (Alaria spp.*) biomass or production between harvested and unharvested sites.*

A total of 10 rocky intertidal, low angle sites, characteristic of *Katharina* habitat will be selected for study. These sites will fall along a gradient of exploitation from heavily harvested to relatively pristine. Highly articulated coastline will be avoided to reduce within site variability. In order to restrict between site variability to wave exposure, care will be taken to maintain slope consistency among sites. Each site will be approximately 50 m in length.

A series of community meetings will be held with interested tribal members, tribal natural resource specialists and local researchers to exchange traditional, local and western information on *Katharina* ecology, discuss relevant questions, and identify high and low harvest areas. This was successfully initiated in the summer of 2002 through one on one meetings with tribal elders and a community potluck organized by the Port Graham Natural Resource Specialist Jim Miller held on July 19th 2002 (Figure 2 & 3). As such, data has already been collected from 4 harvested and 4 unharvested sites (Figure 4). Two more unharvested sites will be selected based on further discussion with local Tribes.

The size frequency and density of *Katharina* will be estimated in the field by counting and measuring all individuals found within 10 randomly stratified 0.25 m^2 quadrats placed along two 50-meter horizontal transects spanning *Katharina* habitat; each site will include a transect in the *Endocladia muricata* (mid-high) and in the *Alaria* (mid-low) zone. Calipers will be used to measure the maximum length of each individual to the nearest 0.5 cm. Size-frequency relationships will then be derived as an indicator of adult growth, survival and juvenile recruitment at each site. This multiple horizontal transect procedure will be used to account for

the spatial variation in of size classes, as larger *Katharina* tend to be found at lower tidal elevations.

The percent cover of dominant algal species (e.g., *Alaria* spp., *Hedophyllum sessile*) and sessile invertebrates, plus counts of dominant mobile invertebrates (e.g., *Katharina, Margarites, Lacuna, Lottia*) will be quantified in the quadrats described above. Percent cover categories used will be 0, 1, 5, 15, 25, 50, 75, 85, 95, 99, and 100%. To account for extensive species overlap and the three-dimensional nature of the community, the canopy, understory and substrate will be surveyed allowing for greater than 100% cover per quadrat. We are beginning these surveys in June-July 2003 and will repeat them in 2004. This methodology was chosen to be consistent with Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and Kachemak Bay National Estuarine Research Reserve (KBNERR) protocols. All data collected will be georeferenced using hand-held GPS. The maximum length of all *Alaria* individuals within the biodiversity quadrats will also be measured.

Primary production, in addition to community structure, could be affected by *Katharina*. A length-biomass relationship will be determined for *Alaria* by measuring the maximum length, drying and weighing individual plants of various sizes. *Alaria* growth rates will be monitored at each site by individually tagging 20 individuals per site, punching a hole in their blade just above their stipe and measuring the change in the distance between the end of their stipe to the punched hole from June to September (otherwise known as the 'conveyor belt method'). This, along with the size frequency and thus biomass data collected for *Alaria*, will allow us to estimate primary production at each site.

Alternative hypotheses for differences among sites include natural variation in disturbance or predation. Wave force at each site will be estimated with maximum wave force recorders (dynamometers, Denny 1985). Sea otter presence will be monitored at each site to estimate natural predation pressure. Shore and 'on water' observations will be made each time a site is visited for monitoring and experimental research. Pilot observations made in the summer of 2002 indicate that there is differential otter presence among the eight sites visited.

2. Experimental Removal of *Katharina*

Null Hypothesis #4: Katharina has no effect on invertebrate and algal community structure or algal productivity.

Katharina will be harvested experimentally beginning in June 2003 from a portion (5 x 5 m) of three traditionally unharvested sites. Based on the size that is traditionally harvested, *Katharina* greater than 6 cm will be reduced in density until catch per unit effort approximates harvested sites (densities to 1/5 or 1/10 of existing densities). Before and after the removal experiment, algal and invertebrate species, in particular algal sporelings, will be quantified inside and outside removal areas once a month from April to August. Permanent 0.25 m^2 quadrats will be used. Experimental plots will be maintained / harvested throughout the year by local project field assistants.

A small-scale experiment will be initiated at one site in August 2003 to quantify the per capita interaction strength of *Katharina* (K) and *Lottia pelta* (L). This experiment mirrors published work by Paine (1992, 2002) on the Washington coast defining per capita and total impacts of grazers on community structure and production. We have chosen to focus on two conspicuous benthic grazers to test for individual and combined effects. Enclosures and

exclosures will be created with Z-spar (30 cm diameter ring) and anti-fouling paint, which grazers rarely cross. Treatments in the fully crossed experiment are: –K+L, +K-L, +K+L, -K-L. Each combination will be replicated 5 times. Treatment controls of Z-spar only will be included to determine total grazer impact. Adult kelps will be removed within the Z-spar arenas at the onset of the experiment in August. The response variable to be measured will be the % cover and biomass of *Alaria* sporelings in the spring (April) 2004.

3. *Katharina* Demography at Exploited and Unexploited sites

Null Hypothesis #5: There is no difference in Katharina fecundity, survival and growth between sites.

Because *Katharina* alters the composition and productivity of prey items, it may experience substantial intraspecific competition at high densities. Indeed, large individuals could even remove new recruits by "bulldozing." Consequently, the harvest of large individuals could actually improve the growth and survival of smaller individuals or increase reproductive output of remaining adults. If such compensatory density dependence occurs, then populations may recover more rapidly than expected after exploitation, as long as recruitment is unimpaired.

To estimate fecundity, we will measure length-specific gonad weight of at least 20 adult individuals from each site, collected by locals for consumption or removed during experimental manipulations. Gonads will be excised, dried and measured following protocols in Salomon (2000).

Survival and growth will be determined through mark-recapture experiments. We will mark up to 100 individual *Katharina* across a wide size range at six sites: three low-density and three high-density sites. Chitons will be double-marked with epoxy putty on their dorsal plates, and a numbered tag will be embedded in the epoxy on one plate. Marking will occur in June 2003, and chitons will be resampled monthly through the summer and again in April 2004. Additional individuals will be marked if recaptures are rare. Length and weight will be measured for all marked individuals to determine summer (June-August) and winter (August-April) growth. Survival will be estimated with Jolly-Seber methods.

4. Current and Future Tribal Involvement

Although the Trustee Council is not emphasizing community-based science in this round of proposals, it is important to point out that this project meets a central goal of GEM by involving tribal members in both design and implementation of research. Summer field assistants will be hired from the villages of Port Graham and/or Nanwalek. As in July 2002, community meetings organized in collaboration with the local Natural Resources Specialists, Fisheries and Environmental staff will be held with the goal of documenting traditional ecological knowledge of *Katharina* and its nearshore ecosystem following the Trustee Council's TEK protocols. This documentation will be spear headed and completed by Henry Huntington, the project's Traditional Ecological Knowledge expert, working closely with local traditional knowledge holders of the Port Graham and Nanwalek communities. At these meetings, scientific, natural history and cultural knowledge of *Katharina* will be shared.

C. Data Analysis and Statistical Methods

One anthropogenic (harvest) and three natural (wave force, recruitment, predation) factors may contribute to spatial variation in density of *Katharina*. To analyze our observational data, we will determine how much of the variation in density of large *Katharina* (>6 cm) can be accounted for by each of these factors, using multiple regression. Harvest pressure will be estimated from interviews with local subsistence harvesters. Wave force will be measured with dynamometers, and predation pressure will be based on observations of sea otters. Recruitment of *Katharina* will be based on densities of small individuals (<2 cm) in the *Endocladia* zone. Community structure / biodiversity data will be analyzed using non-metric multidimensional scaling to look at community-level differences among sites. (N=10 sites)

Changes in kelp density following the large-scale experimental removal of *Katharina* will be analyzed by repeated measures analysis of variance, with experimentally harvested and unharvested treatments paired within sites. (N=3 paired treatments)

Changes in kelp density in response to small-scale manipulations of chitons and limpets will be analyzed using two-factor analysis of variance. In addition, we will compare the +K+L treatment with the no-paint treatment control to determine if enclosing grazers mimics their natural effects.

Size-specific growth and survival data will be collected at three low-density and three high-density sites. Depending on initial results of mark-recapture studies, including distance traveled and ease of recapture, we will mark *Katharina* either at six different sites or inside and outside the large-scale removals. Size-specific fecundity will be collected across all ten sites. We will develop low-density and high-density population models using these basic demographic rates. In addition, we will compare survival, growth rate, and fecundity between low- and high-density sites using analysis of variance.

Here we provide a power analysis indicating that ten quadrats are sufficient to detect differences in *Katharina* across sites. We will have 10 sites, 10 quadrats per site, and an alpha value/significance level of 0.05. We estimate the variance in *Katharina* density to be 7.62 /0.25m^2 based on data collected in Port Graham in July 2002 (Figure 1). We use the power forkmula $F = vn\, S(u_i-u)^2 / ks^2$ (Zar 1999), where k = 10, n = 10, a = 0.05, s^2 = 7.62 /0.25m^2 and U_i = 1.9,1,0.4,5.8,6.6,4.6,5.6,7.8,6,6, giving F = 1.658. Based on Appendix Figure B1 in Zar (1999) for v_1= (k-1) = 8 (*note, no graph exists for v_1 = 9), F = 1.658, and v_2= k(n-1) = 81; **power = 0. 96**. Thus we there will be a 4% chance of committing a Type II error in the proposed *Katharina* density analysis.

D. Description of Study Area

This project will be conducted at the northern most tip of the Kenai Peninsula, home of three small native villages; Port Graham, Nanwalek and Seldovia (N 59.4833, W 152.0000, N 59.1667, W 151.6667). Tribal members have already been involved in site selection and pilot data collection. They will benefit from ecological study of *Katharina* because it remains an important subsistence resource that is apparently declining in some areas.

E. Coordination and Collaboration with Other Efforts

This project will be conducted in collaboration with the Center for Alaskan Coastal Studies (Marilyn Sigman) and the Chugach Regional Resource Council (Paul McCollum). Due

to the degree of tribal participation in this project, it is closely linked to Project 03575; 'Designing a Community Involvement / Community Based Monitoring Plan for GEM'. As Project 03575 is focused on identifying strategies and approaches to provide meaningful community involvement in GEM research and monitoring activities, the proposed research acts as a demonstration project that may illustrate what works and what could be improved upon in terms of tribal involvement in the future.

There is a strong need for developing and nurturing alliances between Tribal Natural Resource research, scientists, educators, and non Tribal natural resource management. Increasing meaningful tribal involvement in nearshore research and monitoring activities will help facilitate stewardship, an awareness of local natural resources and ecosystems and will allow tribal and community derived research questions and hypotheses to be addressed.

This project will help bring about an increased amount of communication and cooperation between scientists and local communities. Researchers are increasingly recognizing that Native people have traditional knowledge that can help answer ecological questions, obtain a clearer understanding of the local behavioral / ecological issues, or even raise entirely new questions. Both Port Graham and Nanwalek have been working with CRRC in developing their Tribal Natural Resource Management Programs. These programs are developed at the local level to ensure long-term ecological health, sustainability of important subsistence resources, and responsible management of lands in proximity to their villages and traditional use areas. CRRC will work closely with the PI to help optimize interaction and communication between the research efforts and the participating villages. Because the Bidarki has been identified as an important subsistence species needing further study at the Tribal level through the Tribal Natural Resource Management planning process, this project will have a high degree of relevance and local interest from the communities involved.

This proposed research complements the Washington, Oregon and California intertidal monitoring initiative of PISCO and the KBNERR intertidal monitoring of Kachemak Bay because it uses the same intertidal monitoring protocol.

III. SCHEDULE

A. Project Milestones

Objective 1. Determine the spatial variation of *Katharina* density and size structure and monitor intertidal biodiversity / community structure at sites within traditional subsistence use areas and unharvested control sites.
To be met by July 2003 and once again in July 2004

Objective 2. Quantify the ecological role of *Katharina* in structuring intertidal communities through experimental removals of *Katharina*.
To be met by August 2003 and once again in August 2004

Objective 3. Estimate the fecundity, survival and growth of *Katharina* to compare demography at exploited and unexploited densities
To be met by May 2004

Objective 4. Promote community involvement in practical, applied research that will provide useful information to the Native communities through education and hands-on experience.
To be met throughout this project

B. Measurable Project Tasks

FY 03, 1st quarter (October 1, 2002-December 31, 2002)

November 25:	Project funding approved by Trustee Council

FY 03, 2nd quarter (January 1, 2003-March 31, 2003)

	Field preparation

FY 03, 3rd quarter (April 1, 2003-June 30, 2003)

June 12:	Community meeting to discuss project and select remaining sites
June 18:	Experimental *Katharina* harvest complete
June 30:	Length-fecundity relationship estimated from regularly harvested individuals

FY 03, 4th quarter (July 1, 2003-September 30, 2003)

July 15:	6 x 100 *Katharina* marked, measured and released
July 30:	Baseline *Katharina* population survey & biodiversity/ Community structure survey complete
August 30:	Native community meeting / potluck in Port Graham and Nanwalek
September 15:	Small-scale experiment set up
September 30:	Present findings to date to Native villages
September 30:	Preliminary TEK report based on community meetings to date – to be completed by September 30, 2004

FY 04, 1st quarter (October 1, 2003-December 31, 2003)

December 15:	Statistical analysis of summer data

FY 04, 2nd quarter (January 1, 2004-March 31, 2004)

(dates not yet known)	Annual EVOS Workshop
March 31:	Recapture and measure tagged *Katharina*
	Record kelp sporelings in small-scale experiment

FY 04, 3rd quarter (April 1, 2004-June 30, 2004)

April 15	Submit final report (which will consist of draft manuscript for publication) to EVOS

FY 04, 4th quarter (July 1, 2004-September 30, 2004)

July 30:	Second baseline *Katharina* population survey & biodiversity/ intertidal community structure survey complete

August 30:	Native community meeting / potluck
August (dates not yet known):	Attendance at the Society for Conservation Biology Annual meeting at Columbia University New York
September 30:	Present key findings and conclusions to native villages
September 30:	Final TEK report based on community meetings complete and made available for distribution
September 30:	draft manuscript complete for peer reviewed journal

IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. Community Involvement and Traditional Ecological Knowledge (TEK)

This proposal involves a strong community participation component and the integration of Traditional Ecological Knowledge (TEK) with Western science. Affected and participating communities will be informed about the project and be given an opportunity to provide their input at two annual community meetings/potlucks to be held in July/August 2003 and 2004. Research findings will be communicated to the native communities at the end of the field season during September 2003 and 2004. Two field assistants will be hired from the local native villages of Port Graham, Seldovia, and/or Nanwalek. Traditional and local knowledge on *Katharina* will be documented by the project's TEK expert, Dr. Huntington, with copies made available by September 30th, 2004.

B. Resource Management Applications

Intertidal invertebrates and algae are often harvested with little to no management information (West 1997) and *Katharina* is no exception. As a broadcast spawner, *Katharina* is likely subject to metapopulation dynamics and like any harvested species, is vulnerable to overexploitation. Community-based monitoring of this resource and the ecosystem upon which it relies would be very instructive and may promote the sustainable harvest of *Katharina*. A well-informed and effective Tribal harvest plan would be incorporated into Tribal Natural Resource Management Plans for each of the participating villages. This harvest plan would be developed based on the population dynamics and ecological role of *Katharina*, Traditional Ecological Knowledge, and Tribal involvement in the research conducted. Furthermore, biodiversity / invertebrate and algal community structure data in control areas can be used as baseline nearshore information. From two-three years of surveys, it should prove possible to begin to define natural variability, against which future change, both natural and anthropogenic, can be assessed. Improved understanding of the marine and coastal ecosystems that support the resources, as well as the people, of the Exxon Valdez spill region will be extremely beneficial.

Marine reserves, also known as harvest refugia, may be an appropriate fisheries management techniques to ensure the sustainable use of benthic marine invertebrates and to conserve intertidal and nearshore ecosystem dynamics. Alaskan Natives of Port Graham and Nanwalek already have a de facto spatially explicit harvest policy, because most subsistence harvest occurs close to villages. However, reserves might be placed differently in space or time

based on the information they gather on the population dynamics of *Katharina*. Limiting the harvest of *Katharina* to several populations while maintaining several source populations (Pulliam 1988) free from fishing effort allows us to investigate the utility and ecological ramifications of marine reserves and promote community involvement and awareness.

V. PUBLICATIONS AND REPORTS

Proposed Peer Reviewed Manuscripts

1. Incorporating Local Coastal Communities and Traditional Ecological Knowledge in Conservation Research
   Submitted to Conservation Biology in Practice by December 2004
2. Impacts of Natural Factors and Shoreline Harvest on the Community Structure, Dynamics and Diversity of the Rocky Intertidal
   Submitted to Marine Ecological Progress Series by December 2004

Proposed Report

1. Traditional Ecological Knowledge of Bidarkis
completed by September 2004

VI. PROFESSIONAL CONFERENCES

We plan to present a paper at the annual Society for Conservation Biology meeting to be held at Columbia University in New York, August 2004 (specific dates are as of yet not posted). We will discuss our current findings on the ecological impacts of traditional native harvest of *Katharina* and how to involve local coastal communities in research.

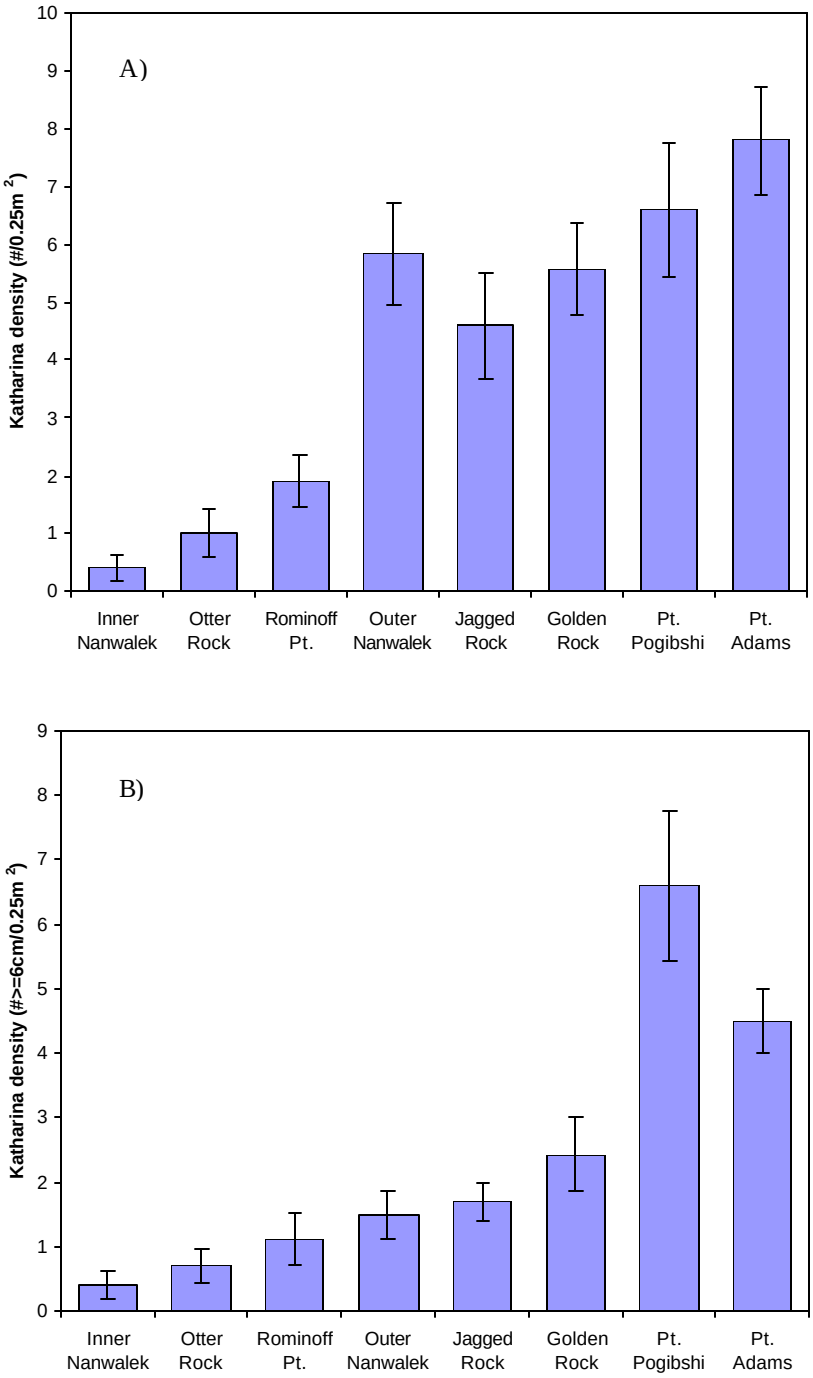

Figure 1 A&B: *Katharina* density per quarter meter square at the zero low tide level (A all individuals, B individuals = 6cm) at 8 sites located at the northern most tip of the Kenai Peninsula. *Katharina* harvest occurs at the first 4 sites although most heavily at the first 3. These sites are arranged in increasing distance from Port Graham and Nanwalek. Data were collected in June and July 2002.

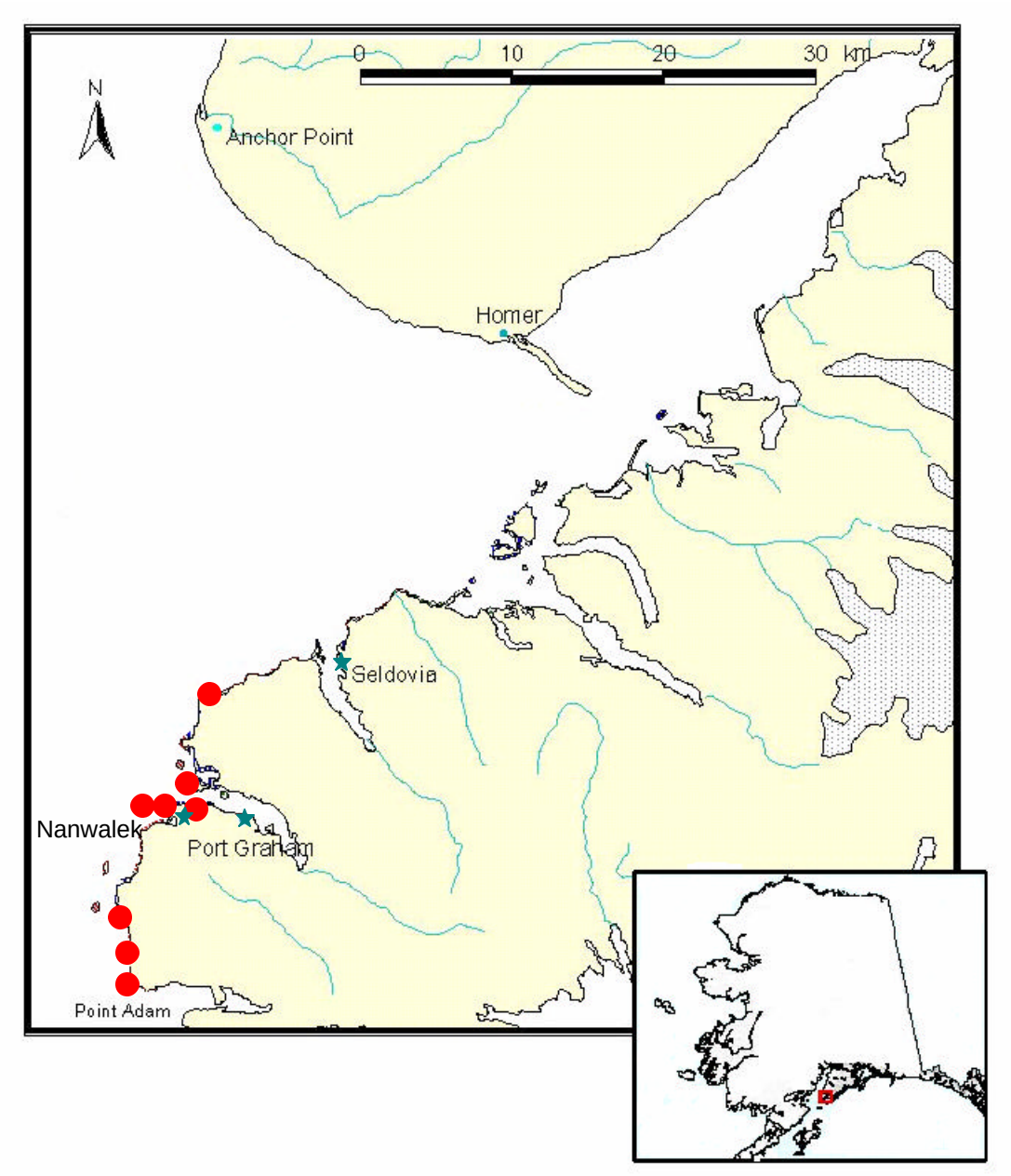

Figure 4: ● Location of sites surveyed in July 2002. ★ Location of Sugpiaq Native Villages.

LITERATURE CITED

Castilla, J. C., and R. H. Bustamante. 1989. Human exclusion from rocky intertidal of Las Cruces, central Chile: effects on *Durvillaea antartica* (Phaeophyta, Durvilleales). *Marine* Ecology Progress Series 50: 203-214.

Castilla, J. C., and L. R. Duran. 1985. Human exclusion from the rocky intertidal zone of central Chile: the effects on *Concholepas concholepas* (Gastropoda). Oikos 45: 391-399.

Chugachmiut. 2000. These Are the Ways of the Sugpiaq in T. F.L., ed, Anchorage, AK.

Dethier, M. N., and D. O. Duggins. 1984. An "indirect commensalism" between marine herbivores and the importance of competitive hierarchies. The American Naturalist 124: 205-219.

Denny, M.W. 1985. Water Motion. In Littler, M. and D. Littler (eds.) Handbook of Phycological Methods-Phycology. Academic Press. New York. p. 7-32.

Denny, M.W., T.L. Daniel, and M.A.R. Koehl. 1985. Mechanical limits to size in wave-swept organisms. Ecological Monographs 55: 69-102.

Dethier, M. N., and D. O. Duggins. 1988. Variation in strong interactions in the intertidal zone along a geographical gradient: a Washington-Alaska comparison. Marine Ecological Progress Series 50: 97-105.

Duggins, D. O., and M. N. Dethier. 1985. Experimental studies of herbivory and algal competition in a low intertidal habitat. Oecologia 67: 183-191.

Francis, R. C. and S.R. Hare. 1994. Decadal-scale regime shifts in the large marine ecosystems of the Northeast Pacific: a case for historical science. Fisheries Oceanography. 3: 279-291.

Jackson, J. B. C., M. X. Kirby, W. H. Berger, K. A. Bjorndal, L. W. Botsford, B. J. Bourque, R. H. Bradbury, R. Cooke, J. Erlandson, J. A. Estes, T. P. Hughes, S. Kidwell, C. B. Lange, H. S. Lenihan, J. M. Pandolfi, C. H. Peterson, R. S. Steneck, M. J. Tegner, and R. R. Warner. 2001. Historical overfishing and the recent collapse of coastal ecosystems. Science 293: 629-638.

Kvasnikoff, Simeon. 2002. Personal communication

Kozloff, E. N. 1973. Seashore Life of the Northern Pacific Coast; An illustrated guide to Northern California, Oregon, Washington, and British Columbia. The University of Washington Press, Seattle.

Markel, R. W., and R. E. DeWreede. 1998. Mechanisms underlying the effect of the chiton *Katharina tunicata* on the kelp *Hedophyllum sessile*: size escapes and indirect effects. Marine Ecology Progress Series 166: 151-161.

Nickerson, R. 1989. Sea Otters; A Natural History and Guide. San Francisco. Chronicle Books.

O'Clair, R. M., and C. E. O'Clair. 1998. Southeast Alaska's Rocky Shores. Plant Press, Auke Bay, Alaska.

Paine, R. T. 1992. Food-web analysis through field measurment of per capita interaction strength. Nature 355: 73-75.

Paine, R. T. 2002. Trophic control of production in a rocky intertidal community. *Science* 296: 736-739.

Pauly, D. and V. Christensen. 1995. Primary production required to sustain global fisheries. Nature 374: 255-257.

Pulliam, H. R. 1988. Sources, sinks, and population regulation. The American Naturalist 132: 652-661.

Russell, P. N. 1991. English Bay and Port Graham Alutiiq Plantlore. Pratt Museum, Homer Society of Natural History, Homer, AK.

Salomon, A.K. 2000. Population viability and biodiversity; Implications for marine protected area. Masters Thesis. University of British Columbia.

Tanapee, Nick. 2002. Port Graham. Personal communication.

Vitousek, P.M. P. R. Ehrlich, A. H. Ehrlich and P.A. Matson. 1986. Bioscience 36: 368-373.

West, J. E. 1997. Protection and restoration of marine life in the inland waters of Washington state. Puget Sound/Georgia Basin Environmental Report Series.

Wootton, J.T. 1997. Estimates and tests of per capita interaction strength: Diet, abundance, and impact of intertidally foraging birds. Ecological Monographs 67: 45-64.

Zar, J. H. 1999. Biostatistical Analysis. Prentice Hall, New Jersey.

http://www.oilspill.state.ak.us/events/Nearshore_2002/nearshorefinalreport.pdf April 2002 *Exxon Valdez* Oil Spill Trustee Council Workshop: Detecting and Understanding Change in Nearshore Environments: Planning for Habitat Mapping in the Gulf of Alaska.

Jennifer L. Ruesink

Department of Zoology, University of Washington
Box 351800
Seattle, WA 98195-1800
Tel: 206-543-7095
Fax: 206-543-3041
Email: ruesink@u.washington.edu

Education

University of Washington, Ph.D. Zoology (1996)

Cambridge University, England, M.Phil. Botany (1990)

Cornell University, B.A. Biology, Summa Cum Laude (1989)

Employment

Assistant Professor, Department of Zoology, University of Washington (Sept. 1999-)

Post-doctoral fellow, Department of Zoology, University of British Columbia (1996-99)

Lecturer, Department of Forest Sciences, University of British Columbia (1998)

Current Responsibilities: Graduate and undergraduate student advising and teaching, marine community ecology research

Expertise

13 years experience studying community ecology of rocky shores of Washington, British Columbia, and Alaska

State and nationally funded research program on biodiversity, species interactions, and population dynamics

Committee service to advise the Olympic Coast Marine Sanctuary/ Olympic National Park on reserve design and intertidal monitoring; and on NRC panel to review GEM

Published record of quantitative expertise in parametric statistics, power analysis, likelihood analysis, matrix modeling, and food web/ Ecopath modeling

Related Publications

Jenkins, C., M.E. Haas, A. Olson & J.L. Ruesink. 2002. Impacts of trampling on a rocky shoreline of San Juan Island, Washington. Natural Areas Journal 22(4):260-269.

Driskell, W.B., J.L. Ruesink, D.C. Lees, J.P. Houghton & S.C. Lindstrom. 2001. Long-term signal of disturbance: *Fucus gardneri* after the *Exxon Valdez* oil spill. Ecological Applications 11:815-827.

Ruesink, J.L. 2000. Assessing density dependence using intraannual counts. Ecology 81:3377-3390.

Ruesink, J.L. 1997. Coral injury and recovery: matrix models link process to pattern. J. Exp. Mar. Biol. Ecol. 210: 187-208.

Paine, R.T., J.L. Ruesink, et al. 1996. Trouble on oiled waters: lessons from the *Exxon Valdez* oil spill. Ann. Rev. Ecol. Syst. 27: 197-235.

Other Publications

Ruesink, J.L. 2003. One fish, two fish, old fish, new fish: which invasions matter? In (S.A. Levin and P.M. Kareiva, eds.) The Importance of Species: Expendability and Triage. Princeton University Press, in press.

Ruesink, J.L., K.E. Hodges and C.J. Krebs. 2002. Mass-balance analyses of boreal forest population cycles: merging demographic and ecosystem approaches. Ecosystems 5:138-158.

Salomon, A.K., J.L. Ruesink, B.X. Semmens and R.T. Paine. 2001. Incorporating human and ecological communities in marine conservation: an alternative to Zacharias and Roff. Conservation Biology 15:1452-1455.

Ruesink, J.L. & D.S. Srivastava. 2001. Numerical and per capita responses to species loss: mechanisms maintaining ecosystem function in a community of stream insect detritivores. Oikos 93:221-234.

Ruesink, J., M. Groom, I. Parker & P. Kareiva. 1995. Reducing the risks of nonindigenous species introductions. BioScience 47: 465-477.

Collaborators

Driskell, William, Driskell and Associates

Hodges, Karen, University of Montana

Houghton, Jon, Pentec

Krebs, Charles, University of British Columbia

Lees, Dennis, Littoral Ecological and Environmental Studies

Lindstrom, Sandra, University of British Columbia

Paine, Robert, University of Washington

Salomon, Anne, University of Washington

Semmens, Brice, University of Washington

Srivastava, Diane, University of British Columbia

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
PROJECT BUDGET

Budget Category:	Proposed FY
Personnel	$38.7
Travel	$5.4
Contractual	$12.2
Commodities	$4.0
Equipment	$0.0
Subtotal (for UW: 60.3-4.14= 56.2)	$60.3
Indirect Cost University of WA (26%) (56.2 * 26%	$14.6
Administration of Funds (9%)	$6.7
Project Total	**$81.6**
Other Funds in kind donation	$12.0

Comments:
The CRRC Project Coordinator, Paul McCollum, will provide time and support as an in kind contribution from CRRC.

Anne Salomon's Graduate Operating Fee (41.4) which has been accounted for in her personal sum is exempt from UW's indirect cost calculation, therefore UW's indirect cost is 26% of $56.2..

We have arranged to rent a boat (16 ft. aluminum skiff) for $2,500/month for 4 months (June through September) during FY 03 & FY04 for a total of $10,000 each year. In case our approved FY03 funds can not be carried over to FY04 we have revised this FY04 budget to reflect the boat rental for FY 04 under the commodities section.

We have also revised Anne Salomon's 'Months Budgeted' to reflect salary increases at UW in FY 04.

FY04

Prepared:
6/2/2003

Project Number:
Project Title: Investigating the Relative Roles of Natural Factors and Shoreline Harvest in Altering the Community Structure, Dynamics, and Diversity of the Kenai Peninsula's Rocky Intertidal Submitted Under the BAA
Name: Dr. Jennifer Ruesink, University of Washington

FORM 4A
NON-TRUSTEE SUMMARY

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
PROJECT BUDGET

Personnel Costs:			Months	Monthly		Personnel
Name	Description		Budgeted	Costs	Overtime	Sum
A. Salomon	Graduate Student/ Principal Field Resear		9.5	2.2	0.0	20.9
(to be hired from 1 of the 3 participating nativ	Research Assistant		3.0	2.3		6.9
(to be hired from 1 of the 3 participating nativ	Resaecrh Assistant		3.0	2.3		6.9
Henry Huntington	TEK Specialist		1.0	4.0		4.0
Paul McCollum	Native Village Liason & Coordinator (in K		2.0	6.0		0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		18.5	16.8	0.0	
					Personnel Total	$38.7

Travel Costs:		Ticket	Round	Total	Daily	Travel
Description		Price	Trips	Days	Per Diem	Sum
A. Salomon	Seattle to Anchorage, Alaska for EVOS/GLOBEC worksho	0.7	1			0.7
A. Salomon	Seattle to Homer, Alaska for field season research	0.8	2			1.6
A. Salomon	Homer, Alaska to PortGraham, Alaska for field research	0.1	12			1.2
A. Salomon	Homer, Alaska to New York for Society for Conservation B	1.0	1			1.0
J. Reusink	Seattle, WA to Port Graham, Alaska for field work	0.9	1			0.9
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$5.4

FY04

Prepared:
6/2/2003

Project Number:
Project Title: Investigating the Relative Roles of Natural Factors and Shoreline Harvest in Altering the Community Structure, Dynamics, and Diversity of the Kenai Peninsula's Rocky Intertidal Submitted Under the BAA
Name: Dr. Jennifer Ruesink, University of Washington

FORM 4B
Personnel
& Travel
DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
PROJECT BUDGET

Contractual Costs:	Contract
Description	Sum
TEK Report	1.0
Manuscript page costs (for Marine Ecological Progress Series)	1.0
Communications	0.2
Boat Rental	10.0
Contractual Total	$12.2

Commodities Costs:	Commodity
Description	Sum
Community involvement meetings	1.0
Fuel	2.0
Boat upkeep (replacement parts)	1.0
Commodities Total	$4.0

FY04

Prepared:
6/2/2003

Project Number:
Project Title: Investigating the Relative Roles of Natural Factors and Shoreline Harvest in Altering the Community Structure, Dynamics, and Diversity of the Kenai Peninsula's Rocky Intertidal Submitted Under the BAA
Name: Dr. Jennifer Ruesink, University of Washington

FORM 4B
Contractual
&
Commoditie

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
PROJECT BUDGET

New Equipment Purchases:		Number	Unit	Equipment
Description		of Units	Price	Sum
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Indicate replacement equipment purchases with an R.			**New Equipment Total**	$0.0

Existing Equipment Usage:	Number	
Description	of Units	

FY04

Project Number:
Project Title: Investigating the Effects of Traditional Native Subsistence Harvest of Katharina Tunicata on Intertidal Community Structure Submitted Under the BAA

FORM 4B
Equipment
DETAIL

Prepared:
6/2/2003

BUDGET JUSTIFICATION FY04

Project Title: **Investigating the Relative Roles of Natural Factors and Shoreline Harvest in Altering the Community Structure, Dynamics and Diversity of the Kenai Peninsula's Rocky Intertidal Submitted Under the BAA**

Proposer: Dr. Jennifer Ruesink
University of Washington
Department of Zoology Box 351800
Seattle, WA 98195-1800
Phone: (206) 685-6893 Fax: (206) 543-3041
ruesink@u.washington.edu

PERSONNEL $38,700

Principal Field Researcher

Anne Salomon is a graduate student in the Zoology Department at the University of Washington. She will be paid as a research assistant (RA) for 2 quarters for each year of funding (for a total of 2 quarters for FY 04). This RAship includes salary, tuition and benefits. She will also be paid a salary throughout the summer field season (June, July, August, September of 2004). Anne's Graduate Operating Fee is not subject to UW's indirect coast of 26%.

Field Assistants

2 field assistants will be hired from the coastal Alaskan villages where this research will take place. One assistant will help on shore, while the others' responsibilities will primarily be as boat tender due to difficult sea conditions. They will be needed for 3 months during the summer field season on FY 04.

TEK specialist

Henry Huntington will be hired as a Traditional Ecological Knowledge (TEK) specialist for one month in FY 04. His valuable knowledge of the Sugpiat culture will be instrumental in creating our proposed TEK report on *Katharina*.

Tribal Liaison and Logistic Coordinator

Paul McCollum will be providing 2 months of logistical and technical support a year as an in kind donation from CRRC.

TRAVEL $5,400

During FY 04, the Principal Investigator Dr. Jennifer Ruesink, or the Principal Field Researcher Anne Salomon, will travel from Seattle, WA to Anchorage for the annual EVOS meeting. During the field season, Anne Salomon will need to travel from Seattle, WA to Homer Alaska to begin the field research. Because some research will have to be conducted in early and/or late winter, she will need to make two trips per year from Seattle to Homer, Alaska onwards to Port Graham, Alaska. Dr. Jennifer Ruesink will fly

to Homer, Alaska and onwards to Port Graham, Alaska once a year to supervise the proposed field work. The remote and isolated native villages from which we will be working out of (Port Graham and Nanwalek, Alaska) are a short flight from Homer. As we will be based out of Homer to be central and close to reliable communication and computing facilities, travel by plane between Homer and Port Graham will occur frequently, at least for each monthly low tide series. We have also budgeted for travel to one international conference in New York in 2004.

CONTRACTUAL$12,200
We will be renting a boat (16 ft. aluminum skiff) from Paul McCollum of Sound Fisheries, for the 4 month field season (June through September FY04). Communications includes the cost for photocopying, postage, long distance phone calls and FAXing. Because we plan on publishing 2 manuscripts and 1 TEK report from this work, we have budgeted for printing and page costs.

COMMODITIES $4,000
Boat upkeep will undoubtedly be required due to the extreme environmental conditions we will be working in. Therefore, we have budgeted for boat repair and extra parts such as spark plugs and extra propellers. Community meetings will occur several times throughout FY 04 and will require financial support for food, communication resources & space rental.

IN-KIND CONTRIBUTION
Paul McCollum from the Chugach Regional Resources Commission will be providing logistical support for 2 months in the summer as an in-kind-donation.

INDIRECT COSTS
University of Washington $14,600
Because this research will be conducted off-campus, in Kachemak Bay, Alaska, an indirect cost of 26% has been requested. As noted earlier Anne's Graduate Operating Fee is not subject to UW's indirect coast of 26%.

Administration of Funds $6,700
9% indirect cost has been calculated for funds administration by NOAA and the Trustee Council.